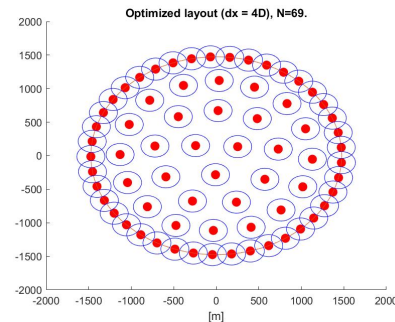
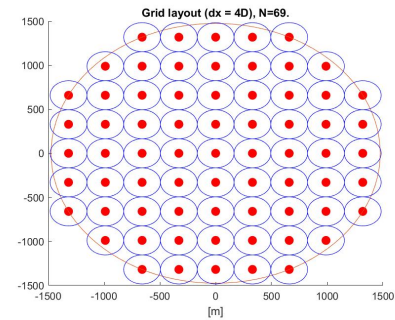


Geometric optimization of wind farms based on minimization of the Coulomb energy

J Trane + E Jørgensen + M Greiner

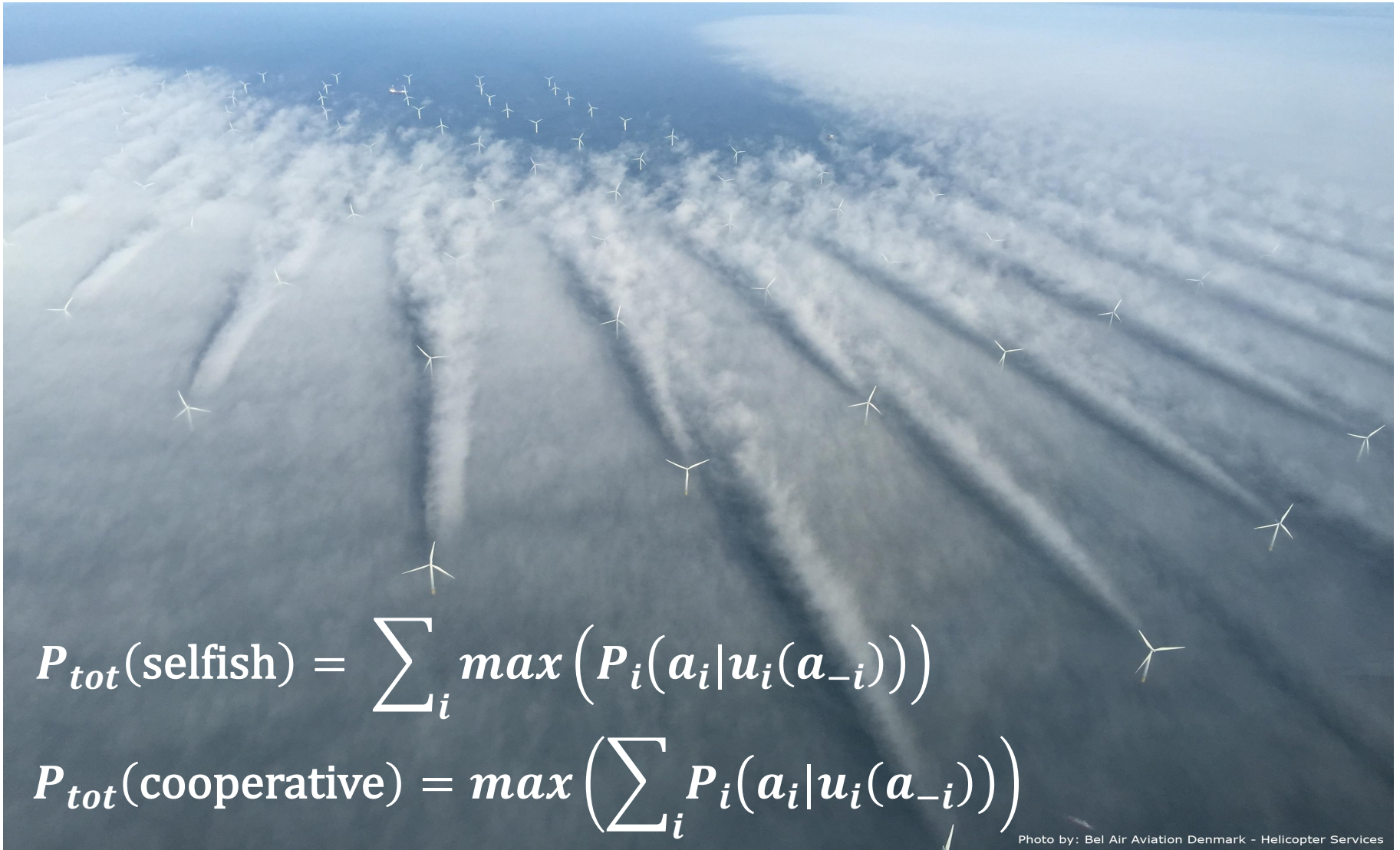
$$\min \sum_{i < j = 1}^N \frac{1}{d_{ij}}$$



Multirotor turbines + wind farms

A Khamas + K Zhu
+ M Abkar + M Greiner

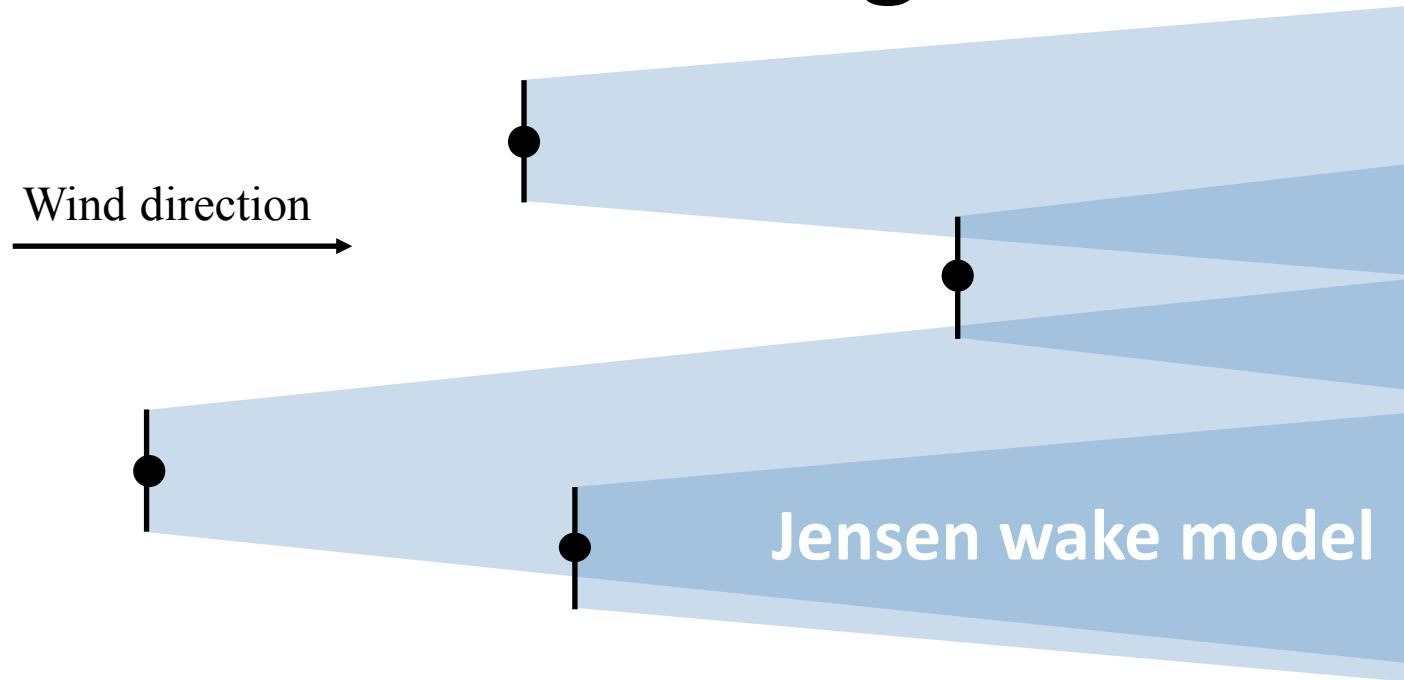
Wind-farm modeling + optimization



$$P_{tot}(\text{selfish}) = \sum_i \max \left(P_i(a_i | u_i(a_{-i})) \right)$$

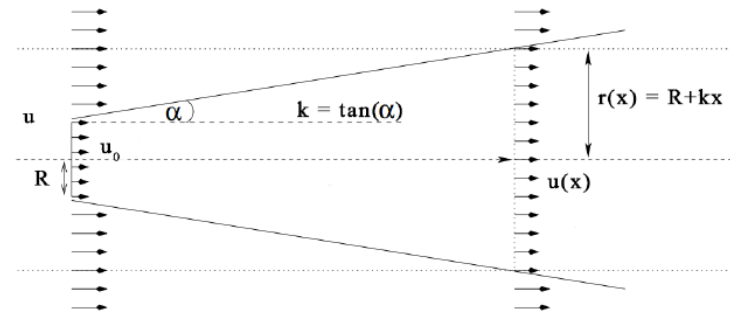
$$P_{tot}(\text{cooperative}) = \max \left(\sum_i P_i(a_i | u_i(a_{-i})) \right)$$

Wind-farm modeling



$$P = \frac{\rho A}{2} C_P(q) u^3$$

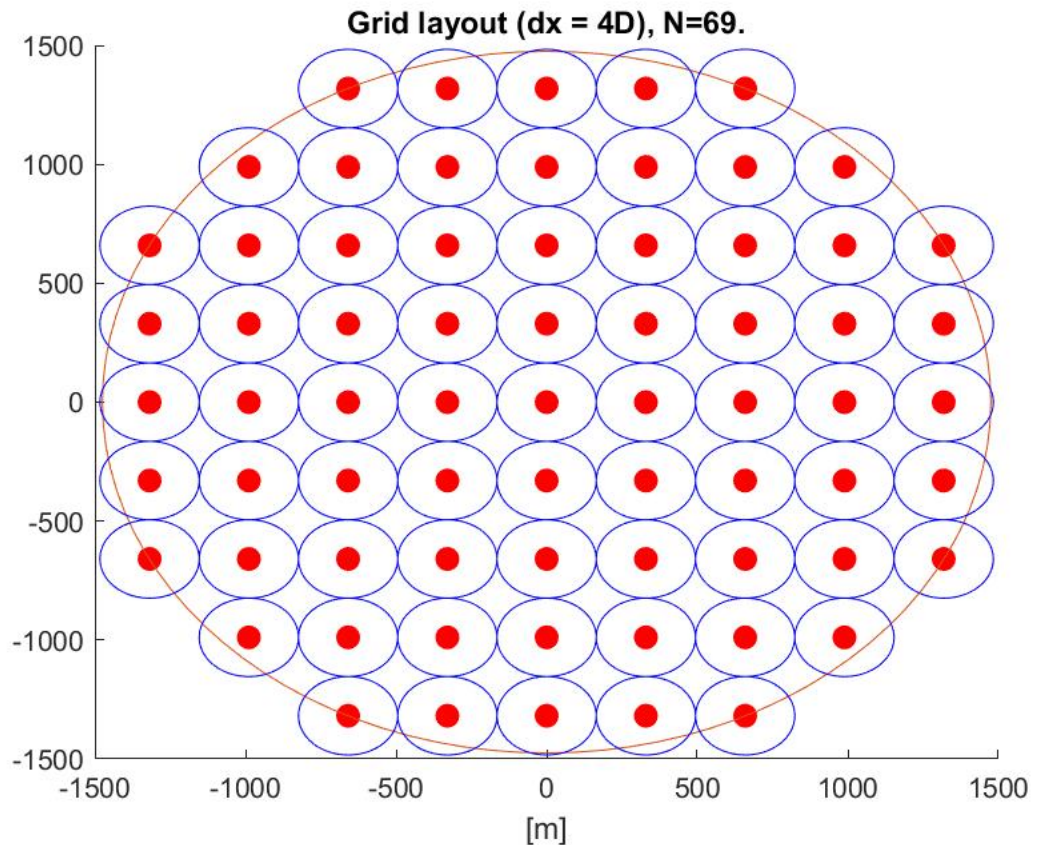
$$C_P(q) = \frac{1+q}{2} (1 - q^2)$$



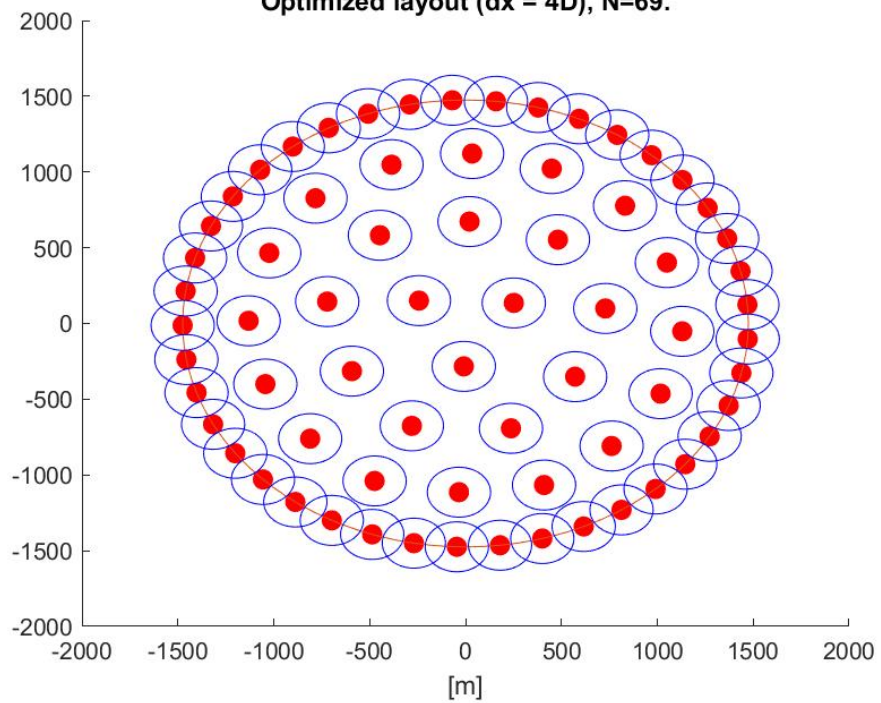
Geometric optimization of wind farms based on minimization of the Coulomb energy

J Trane + E Jørgensen + M Greiner

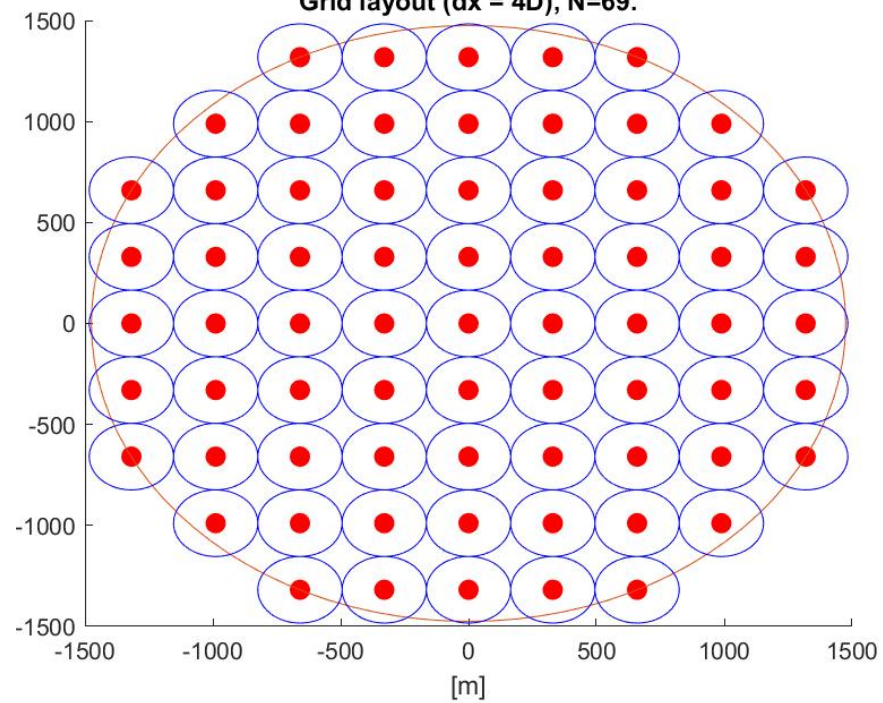
$$\min \sum_{i < j = 1}^N \frac{1}{d_{ij}}$$



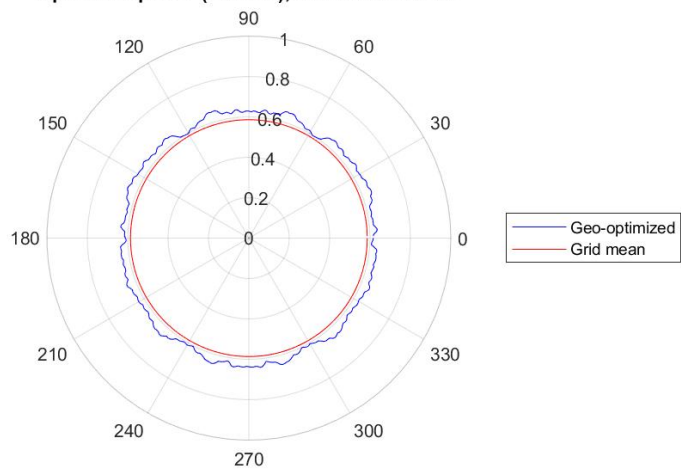
Optimized layout (dx = 4D), N=69.



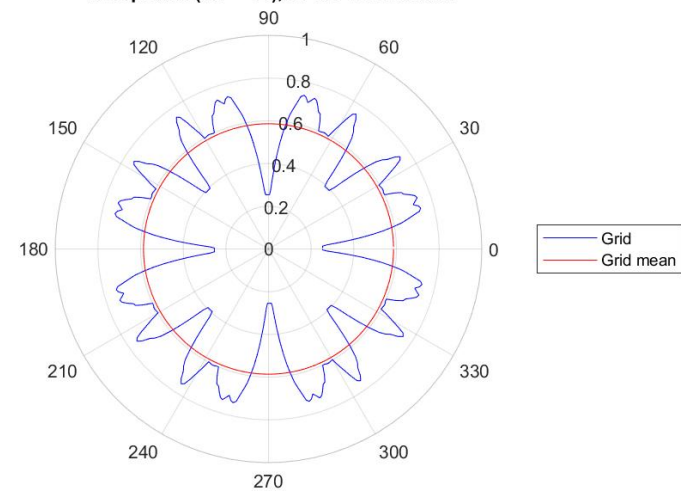
Grid layout (dx = 4D), N=69.



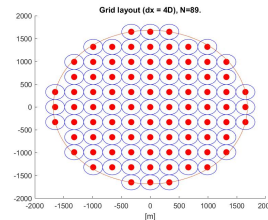
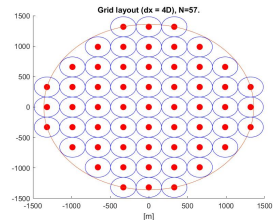
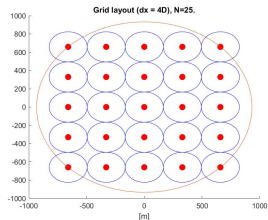
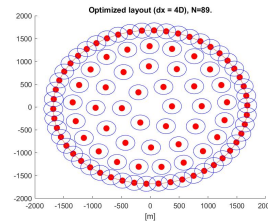
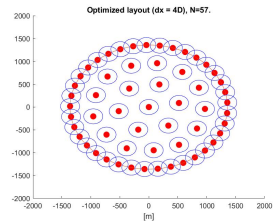
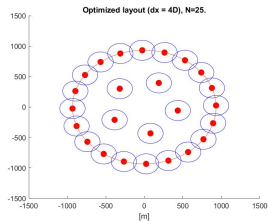
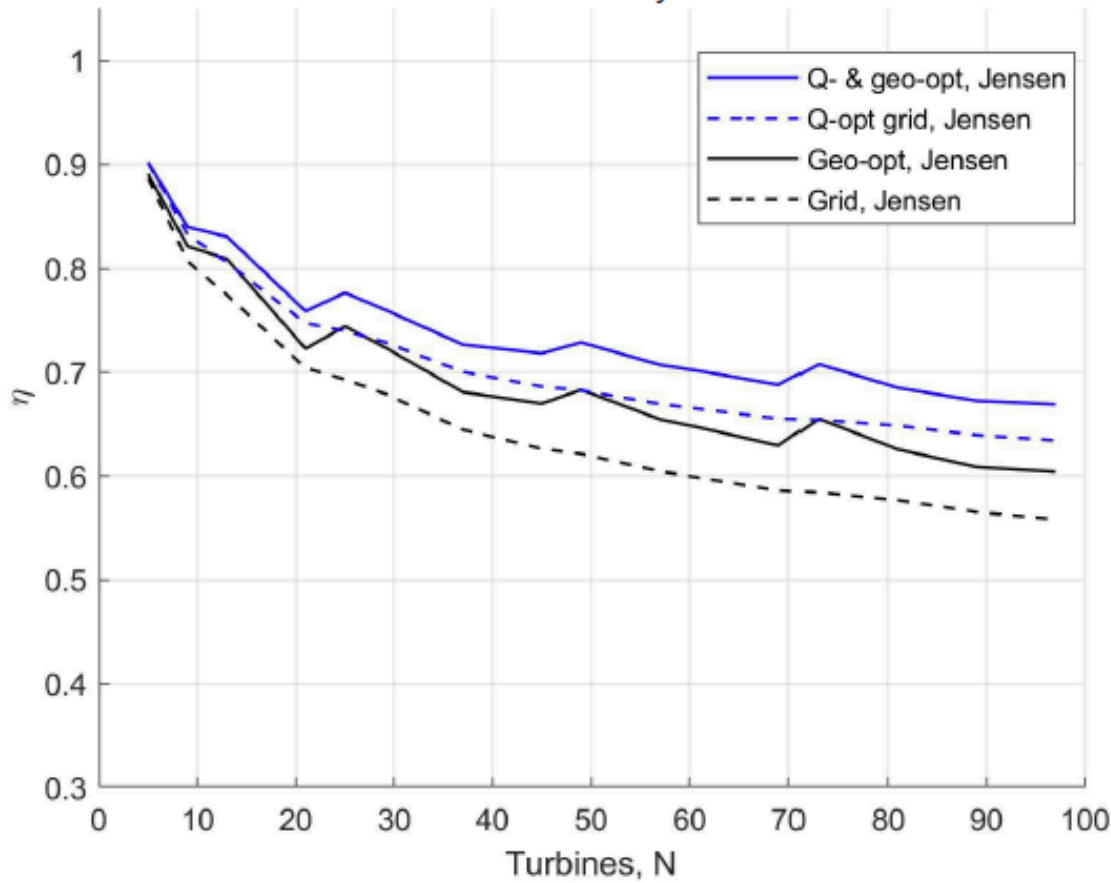
Optimized power (dx = 4D), N=69. Normalized



Grid power (dx = 4D), N=69. Normalized



Efficiency



OUTLOOK:

-- Heterogeneous wind rose,

$$\min \sum_{i < j = 1}^N \frac{1}{d_{ij}(\theta)}$$

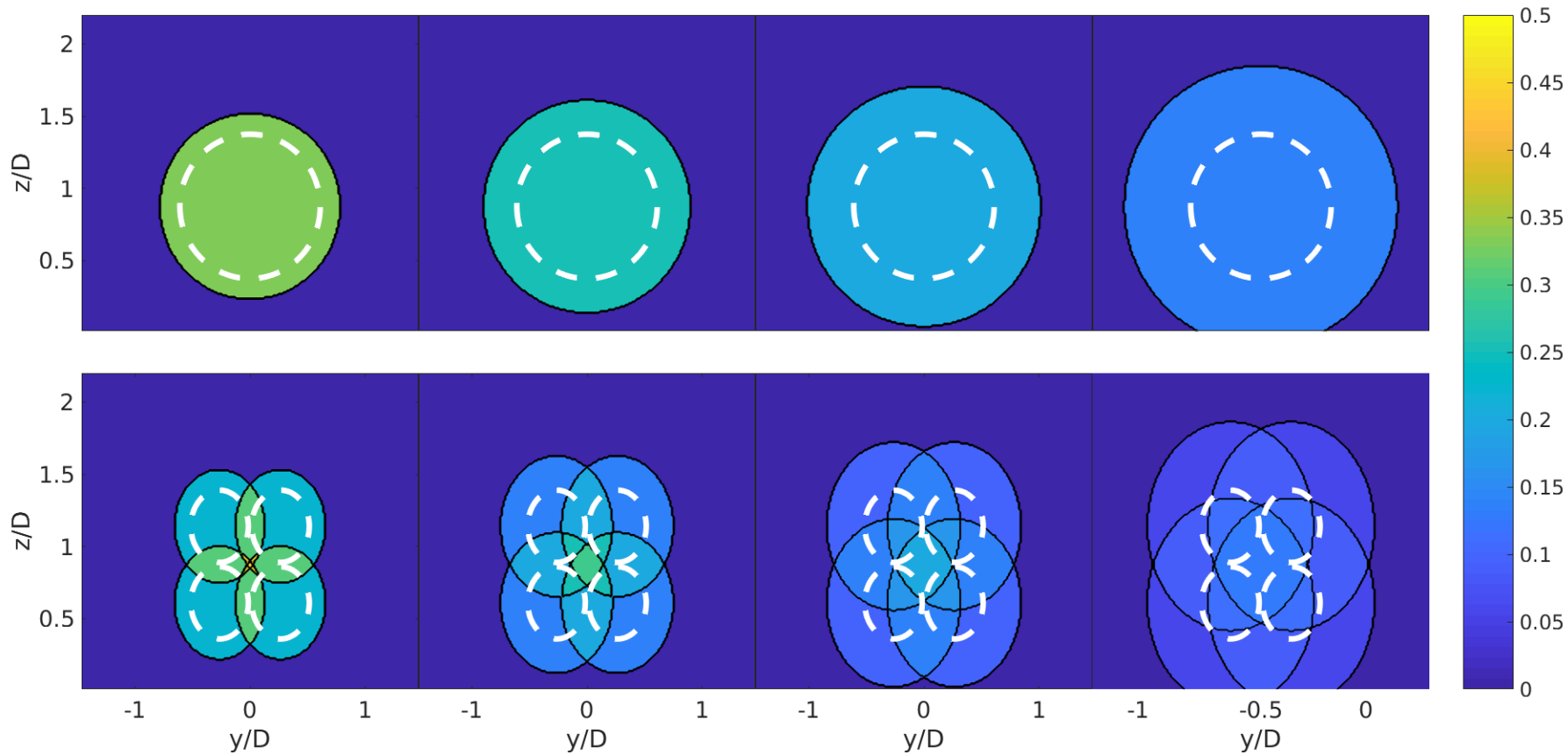
-- Optimal cable layout,

-- Optimal maintenance:
traveling salesman
problem.

Multirotor turbines + wind farms

A Khamas
+ K Zhu
+ M Abkar
+ M Greiner





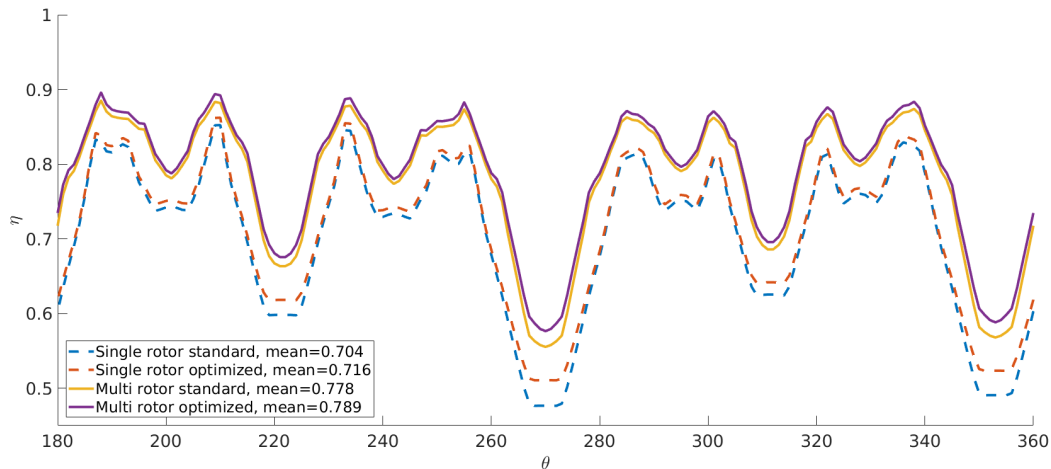
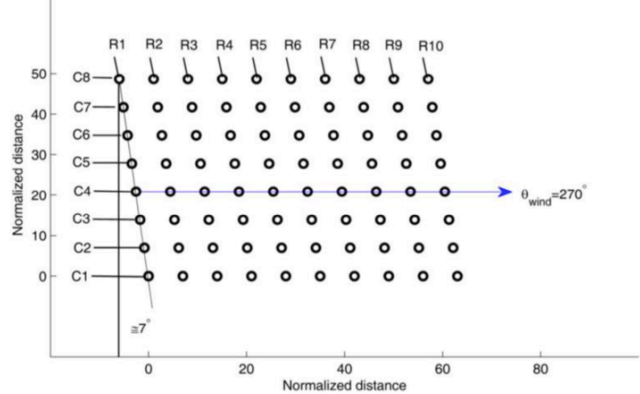
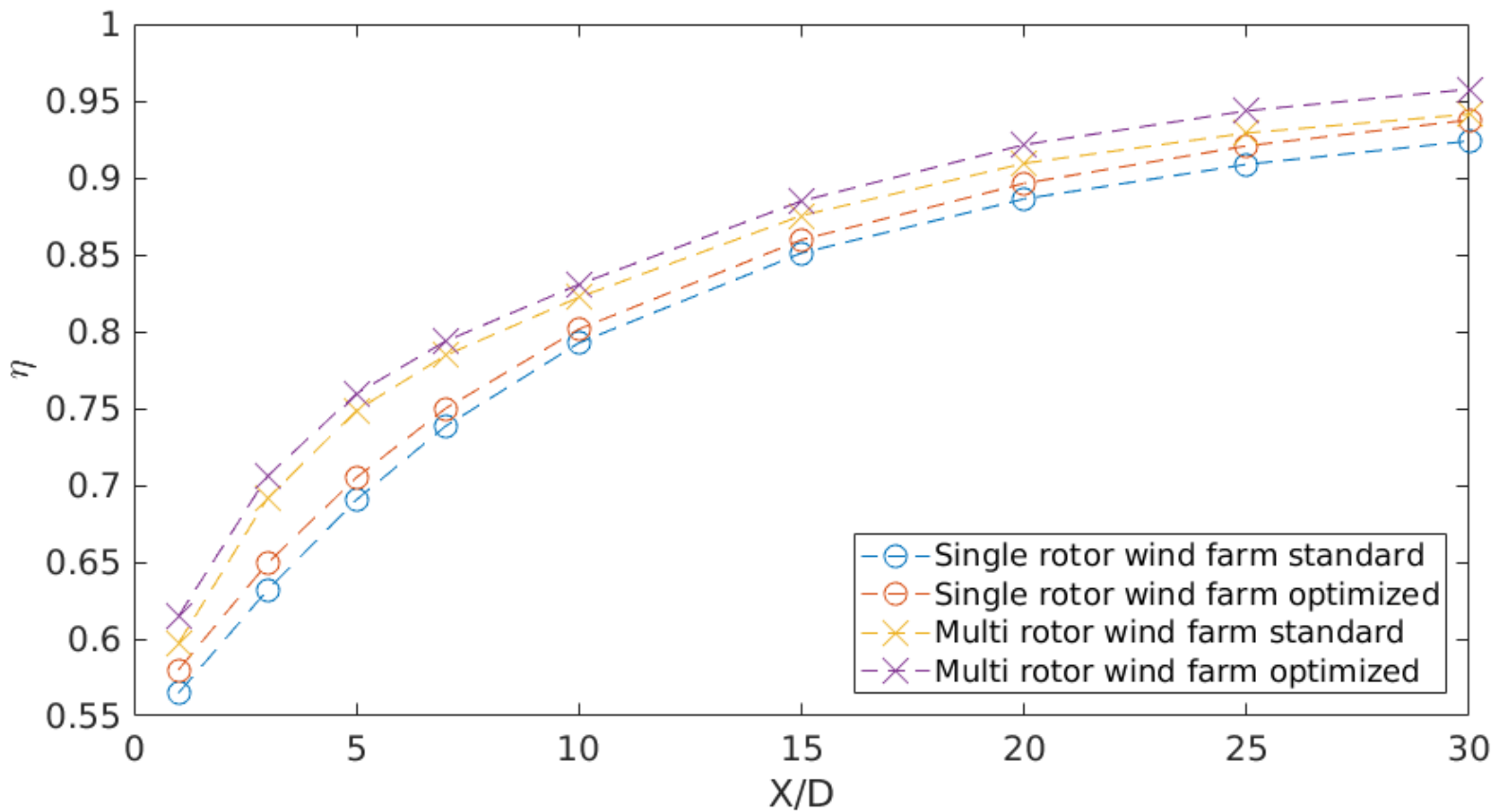


Figure 51: Layout of Horns Rev 1, with turbine naming and wind direction. Source: Niyafar & Porté-Agel [29]



Outlook

